Relationship Between Tillage and Nematicide, Fungicide, and Insecticide Treatments on Pests and Yield of Peanuts Double-cropped with Wheat

N. A. MINTON, USDA-ARS, and A. S. CSINOS, Department of Plant Pathology, and L. W. MORGAN (Emeritus), Department of Entomology, University of Georgia, Coastal Plain Experiment Station, Tifton 31793-0748

ABSTRACT

Minton, N. A., Csinos, A. S., and Morgan, L. W. 1990. Relationship between tillage and nematicide, fungicide, and insecticide treatments on pests and yield of peanuts double-cropped with wheat. Plant Dis. 74:1025-1029.

The relationship between tillage and fenamiphos, aldicarb, PCNB, and chlorpyrifos treatments on damage caused by nematodes, soilborne fungi, and insects and yield of peanuts (*Arachis hypogaea*) double-cropped with wheat was studied. Minimum-tilled peanuts sustained greater damage by *Meloidogyne arenaria* than did conventional-tilled peanuts, but damage by *Pratylenchus brachyurus* was the same in both tillage treatments. Aldicarb and fenamiphos each applied at 2.8 kg/ha at planting were equally effective in reducing nematode damage in both tillage treatments. Mean yields across sites and fungicide-insecticide treatments were increased by nematicides only in 1985. Damage by *Sclerotium rolfsii* was greater with conventional tillage than with minimum tillage. PCNB (11.2 kg/ha) plus chlorpyrifos (2.2 kg/ha) applied in a 30-cm band 55 days after planting suppressed damage by *S. rolfsii*. The mean yield across three sites, 3 yr, two tillage treatments, and three nematicide treatments was 13.6% greater with the fungicide-insecticide treatment than with the control. Damage by *Rhizoctonia solani* did not differ in the two tillage treatments and was reduced significantly by the fungicide-insecticide treatments in only 1 of 3 yr. Mean peanut yield across three sites, 3 yr, three nematicide treatments, and three fungicide-insecticide treatments was 7.5% greater in conventional-tillage than in minimum-tillage plots. Maximum yields were obtained in conventional-tillage plots treated with nematicides and PCNB plus chlorpyrifos.

Seedbed preparation with the moldboard plow is an accepted practice for peanut (*Arachis hypogaea* L.) production. Deep turning of the soil (15–20 cm) with the moldboard plow, or conventional tillage, improves weed (5,27) and disease (2,3) control and soil conditions favorable for root growth (29). For conventionally tilled seedbeds, the soil is usually deep-turned with the moldboard plow to loosen it and to bury plant residue, weed seed, and propagules of fungi. Soil is then disked before planting to destroy weeds, to level the soil, and to incorporate herbicides. This method of soil preparation has been used since the early 1950s because yields are higher than with less intensive tillage (12,13,22).

Minimum tillage disturbs the soil less than conventional tillage and may result in less soil and water loss and may require less energy for cultural practices for many crops in the United States (1). Minimum tillage may be feasible for peanut production (8–10,14). Acceptable weed management systems utilizing herbicides for minimum tillage have been developed (11,30). Pest incidence in minimum-tillage peanuts may differ little from that in conventional-tillage peanuts. Incidence of southern stem rot (*Sclerotium rolfsii* Sacc.) was the same in minimum-tillage and conventional-tillage peanuts in these experiments (10,14,15). Incidence of pod rot (*Pythium myriotylum* Drechs.) differed in two tillage systems in one experiment but was the same in another (31). Numbers of nematodes were the same in minimum-tillage and conventional-tillage peanuts (15). Severity of insect damage in two tillage systems varied with insect species (6,7).

Experiments have not been reported in which the severity of nematodes, diseases, and insects in peanut double-cropped with wheat (*Triticum aestivum* L.) have been compared in minimum tillage and conventional tillage. The objective of this study was to determine the relationship between tillage and pesticides on nematode, fungi, and insect damage in peanuts double-cropped with wheat.

Cooperative investigations of the USDA Agricultural Research Service and the University of Georgia College of Agriculture Experiment Station, Tifton.

This article reports research involving pesticides and does not make recommendations for their use. Mention of a trade name or proprietary product does not constitute a guarantee or warranty of the product by the USDA or the University of Georgia and does not imply its approval to the exclusion of other products that may also be available.

Accepted for publication 30 April 1990 (submitted for electronic processing).

MATERIALS AND METHODS

Three sites were selected at the Coastal Plain Experiment Station, Tifton, Georgia, on the basis of the known presence of nematodes and other peanut pathogens. Soil at site 1 was a Clarendon loamy sand (fine-loamy, siliceous, thermic Plinthaquic Paleudults) infested with *Meloidogyne arenaria* (Neal) Chitwood and *S. rolfsii*. Soil at site 2 was also a Clarendon loamy sand infested with *Pratylenchus brachyurus* (Godfrey) Filipjev & Schuurmans-Stekhoven and *S. rolfsii*. Soil at site 3 was a Tifton loamy sand (fine-loamy, siliceous, thermic Plinthic Paleudults) infested with *S. rolfsii* and *Rhizoctonia solani* Kühn. Each experiment was conducted for 3 yr (1984–1986) on the same site with the same treatments in the same plots each year. All sites were planted to peanuts in the spring and to wheat in the fall of 1983. Wheat harvested in early June preceded peanuts during each year of the experiments.

Each experiment was conducted in a split-split plot with randomized blocks.

Tillage treatments were whole plots, nematicide treatments were subplots, and fungicide-insecticide treatments were sub-subplots. Tillage treatments were conventional tillage and minimum tillage. Nematicide treatments were aldicarb (2.8 kg/ha), fenamiphos (2.8 kg/ha), and control, and fungicide-insecticide treatments were PCNB (11.2 kg/ha) plus chlorpyrifos (2.2 kg/ha), chlorpyrifos (2.2 kg/ha), and control. Each sub-subplot consisted of two rows 0.96 m wide × 7.6 m long. Treatments were replicated four times. Soil in conventional-tillage plots was double-disked and turned 20 cm deep. Soil was pulverized as low, flattop beds were formed, and preemergence herbicides were incorporated with a Rototiller. Seeds of cv. Florunner peanut were planted between 1 and 5 June each year at 135 kg/ha. A Flexi-planter equipped with gauge shoes was used to plant conventional-tillage plots and a subsoiler no-till planter was used to plant the minimum-tillage plots in fallow and wheat stubble 20 cm high. Subsoiler shanks ran 36 cm deep, followed by a double-fluted coulter with attached press wheels that backfilled the subsoiler slit and prepared a 12-cm-wide seedbed. Nematicides were applied in a 30-cm band ahead of the planter. Chlorpyrifos and PCNB were applied in a 45-cm band over the row 55 days after planting.

Preplant herbicides were benefin (1.7 kg/ha) and metolachlor (1.7 kg/ha) for conventional tillage and glyphosate (1.1 kg/ha), pendimethalin (1.1 kg/ha), and metolachlor (2.2 kg/ha) for minimum tillage. Preemergence herbicides applied to both tillage treatments were naptalam (2.2 kg/ha), dinoseb (1.1 kg/ha), and alachlor (4.5 kg/ha). Postemergence herbicides applied to both tillage treatments were bentazon (1.1 kg/ha) at site 3 only in 1984 and sethoxydim (0.2 kg/ha) at all sites in 1985. Conventional-tillage plots were also cultivated as needed to control weeds. Chlorothalonil was applied on a 14-day schedule beginning 30 days after seeding to control foliar diseases. Methomyl, fenvalerate, monocrotophos, dicofol, and propargite were used as needed to control foliar insects.

Fertilizer was applied as recommended on the basis of soil tests for peanut and wheat production in Georgia. Gypsum (calcium sulfate) was applied at 600 kg/ha in a 30-cm band over the row at early bloom stage of peanut. The experiments were irrigated within 48 hr of seeding if significant rainfall did not occur and subsequently as needed during the growing season.

Stand counts were based on the number of plants emerged per 2 m of row 14 days after seeding. Soil samples collected from the root zone 1–3 wk before harvest were assayed for nematodes using the centrifuge-sugar flotation method (16). Each year at digging-inverting, roots, pods, and pegs at site 1 were evaluated for root-knot galling caused by *M. arenaria* and pods at site 2 were evaluated for the presence of lesions caused by *P. brachyurus*. Numbers of *P. brachyurus* in the shells were determined in 1985 and 1986. Ten plants per plot at site 1 were evaluated on a scale of 1–5, with 1 = no galls and 2 = 1–25%, 3 = 26–50%, 4 = 51–75%, and 5 = 76–100% of roots and pods galled. At site 2, lesions on pods of 10 plants were rated based on a scale of 1–5, with 1 = no lesions on pods and 2 = 1–25%, 3 = 26–50%, 4 = 51–75%, and 5 = 76–100% of pod surface covered with lesions. The number of *P. brachyurus* were counted after 5 g of shells were comminuted in a food blender for 30 sec and incubated on a Baermann funnel for 48 hr. Damage by *S. rolfsii* was determined by counting the number of loci per 15.2 m of row within 12 hr after digging-inverting. A locus was defined as one or more symptomatic plants per 31 cm of row (25). A similar rating for damage by *R. solani* (expressed in percentage of plant damage) was obtained at site 3 at the time of digging-inverting. Pod damage by insects was determined in 1984 from 100 randomly selected harvested pods. Pod yield was calculated at 8% moisture, and the percentage of sound mature kernels was determined on a 300-g sample.

Analysis of variance of the data was determined by the general linear model procedure according to SAS (26). Harmonic means were utilized in determining average variance of applied treatments (28). Differences are significant at $P = 0.05$ unless otherwise indicated.

RESULTS

Fenamiphos and aldicarb were equally effective for nematode control. The chlorpyrifos treatment had no effect on damage to peanut pods by soil insects in 1984 (data not shown) and little or no effect on other pests as well as yield. Therefore, data for the two nematicides were combined and data for chlorpyrifos and the control were combined for analysis and presentation.

Population density of *M. arenaria* at site 1 was relatively low (data not shown) and root galling was not severe (Table 1). Nematicides significantly reduced the number of juveniles of *M. arenaria* in soil only in 1984 (data not shown). The mean numbers of juveniles per 150 cm^3 of soil across years, tillage treatments, and fungicide-insecticide treatments were 202 and 91 in the control and nematicide-treated plots, respectively. The root-knot index across years, nematicide treatments, and fungicide-insecticide treatments was lower in the conventional-tillage (1.5) than in the minimum-tillage (2.0) treatment. Root-knot indices across tillage treatments and fungicide-insecticide treatments were significantly lower in the nematicide treatment than in the control each year (Table 1).

P. brachyurus damaged peanuts at site 2. The lesion indices each year and the numbers of *P. brachyurus* per 5 g of shells in 1985 and 1986 across tillage treatments and fungicide-insecticide treatments were reduced by nematicide treatments (Table 2).

Peanut plants were damaged by *R. solani* at site 3, and its incidence was reduced significantly only in 1984 by the fungicide-insecticide treatments (data not shown). The mean percentages of plants damaged by *R. solani* across all treatments ranged from 5.5 in 1985 to 36.1 in 1986.

There was a significant interaction effect ($P = 0.01$) among sites, tillage treatments, and fungicide-insecticide treatments in the incidence of *S. rolfsii*, but years × fungicide-insecticide treatments and sites × fungicide-insecticide treatments were not significant. The incidence of *S. rolfsii* was significantly lower in the fungicide-nematicide treatment than in the control in both tillage treatments at all sites (Table 2). The mean number of *S. rolfsii* loci across sites, years, nematicide treatments, and fungicide-insecticide treatments was significantly greater in the conventional-

Table 1. Effects of nematicides on root-knot indices of peanut roots, pods, and pegs, lesion indices of peanut pods, and number of *Pratylenchus brachyurus* in peanut hulls[a]

	Site 1			Site 2					
	Root-knot index[b]			Lesion index[c]			Number of *P. brachyurus* per 5 g of shells		
Year	Control	Nematicide	LSD 0.05	Control	Nematicide	LSD 0.05	Control	Nematicide	LSD 0.05
1984	3.1	1.4	1.0	2.0	1.1	0.4	...	...	...
1985	2.1	1.6	0.3	2.2	1.4	0.2	7,042	1,393	2,412
1986	1.7	1.4	0.2	2.3	2.0	0.3	4,354	1,797	1,107
Mean	2.3	1.5	0.3	2.1	1.5	0.1	5,698	1,595	1,257

[a] Averaged across two tillage treatments and three fungicide-insecticide treatments.
[b] Based on a scale of 1–5, with 1 = no galling and 2 = 1–25%, 3 = 26–50%, 4 = 51–75%, and 5 = 76–100% of roots, pods, and pegs galled.
[c] Based on a scale of 1–5, with 1 = no lesions on pods and 2 = 1–25%, 3 = 26–50%, 4 = 51–75%, and 5 = 76–100% of surface of peanut pods covered with lesions.

tillage (8.5) than in the minimum-tillage (6.4) treatment. The number of *S. rolfsii* loci per 15.2 m of row across all sites and treatments in 1986 (14.3) was greater than that in 1984 (3.3) and 1985 (4.3).

Thrips damage was slightly more severe in conventional-tillage plots than in minimum-tillage plots in 1984; severity data were not collected, however. Pod damage by insects did not differ among treatments in 1984 (data not shown).

The plant population densities per 2 m of row across all sites and treatments were 23.7, 17.1, and 26.8 in 1984, 1985, and 1986, respectively. Nematicide and fungicide-insecticide treatments had no effect on stand, but stand was 17.4% ($P = 0.01$) greater in conventional-tillage than in minimum-tillage plots.

There were year × tillage and year × nematicide treatment interactions for peanut yield (Table 3), but other interactions were not significant. Yields across sites, nematicide treatments, and fungicide-insecticide treatments in 1984 and 1985 were greater in conventional-tillage plots than in minimum-tillage plots, but the difference between tillage treatments in 1986 was not significant. Yield differences for nematicide treatments were significant only in 1985.

The mean yield across sites, years, and fungicide-insecticide treatments was significantly greater (7.5%) in conventional-tillage than in minimum-tillage plots and also greater (3.7%) for the nematicide treatments than for the control (Table 3). The fungicide-insecticide treatment increased yields significantly over the control each year at each site (data not shown). Mean yields across years, sites, tillage treatments, and nematicide treatments were 4,159 kg/ha for the control and 4,726 kg/ha for the fungicide-insecticide treatments, or 13.6% greater for fungicide-insecticide treatment. The mean yield across sites, years, and treatments was negatively correlated ($P = -0.01$) with the number of *S. rolfsii* loci per 15.2 m of row ($r = 0.64$).

The greatest mean yield across sites and years was obtained in the conventional-tillage plots that received nematicides and fungicide-insecticide treatments (Fig. 1). The smallest mean yield across sites and years was obtained in minimum-tillage plots with no nematicide and fungicide-insecticide treatments. With no nematicide and fungicide-insecticide treatments, yield in conventional-tillage plots was 12.8% greater than that in minimum-tillage plots. In conventional-tillage plots, the addition of the fungicide-insecticide treatment increased yields 10.3% over those in the control, but the addition of nematicides did not increase yields significantly.

The percentage of sound mature kernels across sites, years, nematicide treatments, and fungicide-insecticide treatments was significantly higher ($P = 0.01$) in the conventional-tillage (78.5%) than in the minimum-tillage treatment (77.9%). Sound mature kernels across sites, tillage treatments, and nematicide treatments were increased significantly ($P = 0.01$) from 78.0% for the control to 78.5% for the fungicide-insecticide treatment. Other treatment effects, including interactions, were not significant.

Table 2. Effects of fungicide-insecticide and tillage treatments on incidence of *Sclerotium rolfsii* in peanuts[a]

	Number of loci per 15.2 m of row[b]					
	Conventional tillage			Minimum tillage		
Site	Control	Fungicide-insecticide	LSD 0.05	Control	Fungicide-insecticide	LSD 0.05
1	11.9	6.9	1.7	7.9	5.8	1.7
2	7.8	5.0	1.3	7.0	4.3	1.3
3	11.1	8.3	1.6	8.6	4.6	1.6
Mean	10.3	6.7	0.9	7.8	4.9	0.9

[a] Averaged across years and three nematicide treatments.
[b] A locus was one or more peanut plants per 31 cm of row having visual symptoms of *S. rolfsii* infection.

Table 3. Effects of tillage and nematicide treatments on yield of peanut cultivar Florunner

	Yield (kg/ha)					
	Tillage treatment[a]			Nematicide treatment[b]		
Year	Conventional	Minimum	LSD 0.05	Control	Nematicide	LSD 0.05
1984	5,317	4,930	327	5,096	5,137	NS[c]
1985	4,752	3,949	197	4,137	4,457	155
1986	3,515	3,755	NS	3,565	3,670	NS
Mean	4,528	4,211	152	4,265	4,421	99

[a] Averaged across three sites, three nematicide treatments, and three fungicide-insecticide treatments.
[b] Averaged across three sites, two tillage treatments, and three fungicide-insecticide treatments.
[c] NS = not significant.

DISCUSSION

The failure to obtain a yield response to nematicides at site 1 was apparently due to the low initial level of *M. arenaria* in the soil and its failure to increase appreciably with continuous peanuts. Although root-knot indices were greater in the minimum-tillage than in the conventional-tillage plots, the small differences that occurred were not meaningful in terms of yield because of the low level of infection. In previous nematode studies in this field, *M. arenaria* was a serious pathogen on soybean (20) and peanut (19). In 1988, however, the bacterium *Pasteuria penetrans* (Thorne, Sayre, and Starr) was found infecting *M. arenaria* in this field, and we believe that this organism has a significant suppressing effect on this nematode (21). At site 2, the yield increase due to nematicides was small (270 kg/ha) but significant. The similar levels of nematode control in the minimum-tillage and conventional-tillage treatments suggest that contact nematicides were equally effective in the two tillage systems.

S. rolfsii was present at all test sites and was the major fungal parasite affecting peanuts, although *R. solani* was also present at site 3. The reason for the much higher incidence of *S. rolfsii* in 1986 than in 1984 and 1985 may have been the higher soil temperatures in 1986 than in 1984 and 1985, as well as a buildup of the fungus in the soil resulting from continuous peanut. The mean soil temperature at the 5-cm depth during July of 1986 was 4.3 C, or 2.7 C greater than in 1984 and 1985. The higher incidence of *S. rolfsii* in the conventional-tillage plots than in the minimum-tillage plots agrees with previous results (14). The residue from the previous crops of wheat and peanuts left on the soil surface in the minimum-tillage treatment did not increase the prevalence of *S. rolfsii* but may have reduced it compared with the conventional-tillage treatment. Deep burial of all plant residue with the moldboard plow in tilled peanuts has long been considered essential for suppression of *S. rolfsii* (2,4). Factors affecting the development of *S. rolfsii* may be different in the two tillage systems if burial of plant residue in tilled peanuts is, in fact, necessary for suppression of *S. rolfsii*. The incidence of *R. solani* was reduced by the fungicide-insecticide treatment in only 1 yr, but the incidence of *S. rolfsii* was reduced all years and at all sites. The fungicide-insecticide treatment suppressed *S. rolfsii* in the two tillage treatments.

The reasons for the greater yield with

the conventional-tillage than with the minimum-tillage treatment for 2 of 3 yr is not clear. Yields reported by others have varied in comparisons of the two tillage systems (9,15,30). The greater yield with conventional tillage than with minimum tillage cannot be attributed to differences in damage caused by nematodes or *S. rolfsii.* Plant damage caused by *M. arenaria* was greater with minimum tillage than with conventional tillage at site 1, and damage caused by *S. rolfsii* was greater with the conventional tillage at all sites. Considering the relative severity of these two pests and the fact that *M. arenaria* occurred at only one site and *S. rolfsii* occurred at all sites, it appears that damage due to pests should have been greater with conventional tillage than with minimum tillage, which should have resulted in greater yields in the minimum-tillage plots than in the conventional-tillage plots, assuming that all other factors were equal.

Soil strength measurements collected in a previous, unrelated experiment within 0.5 km of these test sites showed that soil strength was greater with minimum tillage than with conventional tillage except within the subsoiler trench (in the row) (24). Although soil strength data were not obtained in this experiment, compaction may have been present in the pegging zone in the minimum-tillage treatment that restricted root growth, pod set, and subsequent yields compared with the conventional-tillage treatment.

The greater stand in conventional-tillage plots than in minimum-tillage plots apparently did not contribute to yield differences. Stand was not correlated ($P = 0.05$) with yield. The mean plant spacings of 9.7 cm for minimum tillage and 8.2 cm for conventional tillage in this experiment were within the range in which others have obtained maximum yield of runner-type peanuts in tilled seedbeds (17,18,23). Also, annual differences in plant density fluctuation did not coincide with changes in yield. Plant density was greatest in 1986 and least in 1985, yet peanut yields were greatest in 1984 and least in 1986. The relatively high incidence of *S. rolfsii* in 1986 probably contributed to the low yield in 1986. Growing peanuts on the same land each year for several years may have contributed to the increased incidence of *S. rolfsii.* Boyle (4) determined that the incidence of *S. rolfsii* was reduced and that peanuts generally did better following a monocotyledonous crop.

Poor weed control in minimum tillage has been shown to reduce peanut yields compared with good weed control in conventional tillage (11,30). However, weed control was adequate and equal in both tillage treatments in this experiment.

Minimum tillage may be an acceptable cultural practice for late-planted peanuts following wheat when time required for conventional tillage practices is a limiting factor. However, the time saved by minimum tillage may not always justify the loss in yield of an average of 317 kg/ha. Also, costs of herbicides for minimum-tillage may exceed that for conventional-tillage culture.

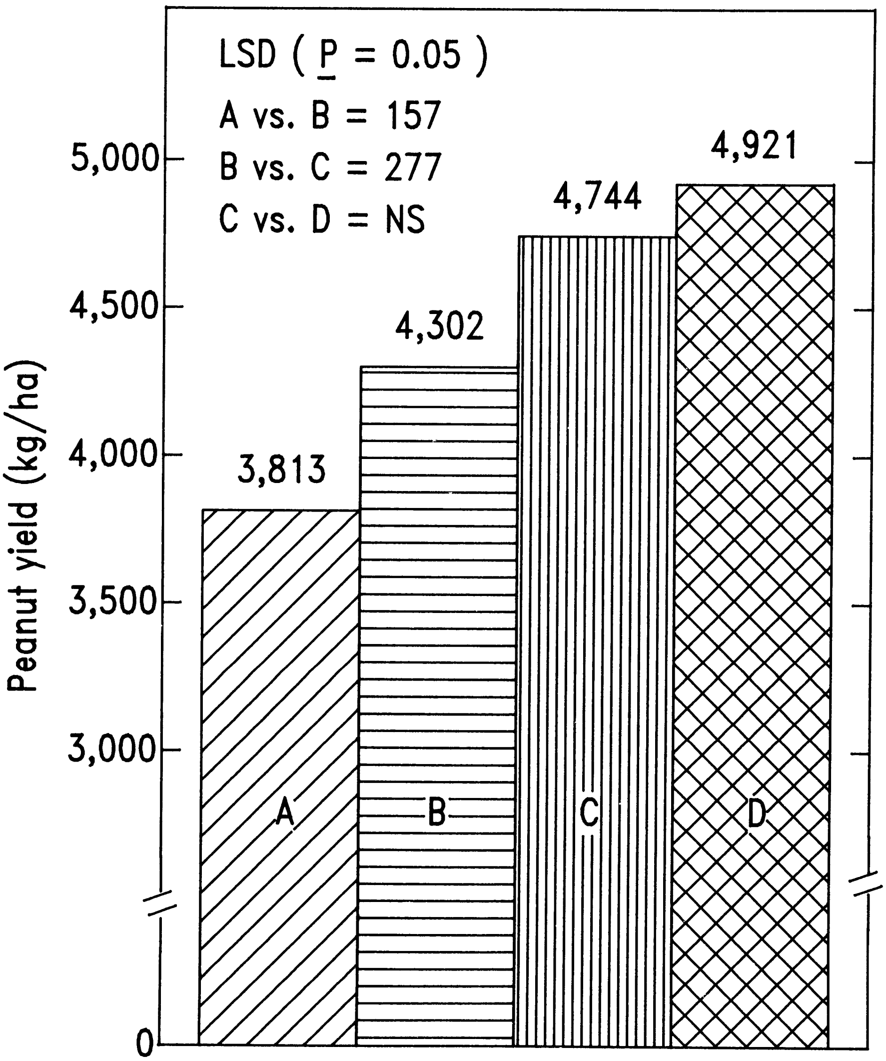

Fig. 1. Peanut yield as affected by selected treatments and combination of treatments (averaged across sites and 3 yr): **(A)** Minimum tillage without nematicide or fungicide-insecticide treatments, **(B)** conventional tillage without nematicide or fungicide-insecticide treatments, **(C)** conventional tillage plus fungicide-insecticide treatments, and **(D)** conventional tillage plus nematicide and fungicide-insecticide treatments.

ACKNOWLEDGMENTS

This research was funded in part by the Georgia Agricultural Commodity Commission for Peanuts. We thank M. B. Parker for assistance in statistical analysis of the results.

LITERATURE CITED

1. Anonymous. 1987. The 1986 National Survey of Conservation Tillage Practices. Conservation Tillage Information Center, Fort Wayne, IN. 142 pp.
2. Boyle, L. W. 1952. Factors to be integrated in control of Southern blight on peanuts. (Abstr.) Phytopathology 42:282.
3. Boyle, L. W. 1956. Fundamental concepts in the development of control measures for southern blight and root rot on peanut. Plant Dis. Rep. 40:661-665.
4. Boyle, L. W. 1967. A factorial study of certain schemes of peanut culture. Univ. Ga. Agric. Exp. Stn. Res. Bull. 18. 19 pp.
5. Buchanan, G. A., and Hauser, E. W. 1980. Influence of row spacing on competitiveness and yield of peanuts. Weed Sci. 28:401-409.
6. Campbell, W. V. 1986. Effect of no-till and double-cropped peanuts on insect population, damage and peanut yield. Proc. Am. Peanut Res. Educ. Soc. 18:44.
7. Campbell, W. V., Sullivan, G. A., and Rogister, E. W. 1985. Comparison of pests and pest damage in no-till and conventionally-planted peanuts. Proc. Am. Peanut Res. Educ. Soc. 17:61.
8. Cheshire, J. M., Jr., Hargrove, W. L., Rothrock, C. S., and Walker, M. E. 1985. Comparison of conventional and no-tillage peanut production practices in Central Georgia. Pages 82-86 in: Proc. South. Reg. No-till Conf. W. L. Hargrove, C. F. Boswell, and G. W. Langdale, eds. University of Georgia, Athens.
9. Colvin, D. L., and Brecke, B. J. 1988. Peanut cultivar response to tillage systems. Peanut Sci. 15:21-24.
10. Colvin, D. L., Brecke, B. J., and Whitty, E. B. 1988. Tillage variables for peanut production. Peanut Sci. 15:94-97.
11. Colvin, D. L. Wehtje, G. R., Patterson, M., and Walker, R. H. 1985. Weed management in minimum-tillage peanuts (*Arachis hypogaea*) as influenced by cultivar, row spacing, and herbicides. Weed Sci. 33:233-237.
12. Garren, K. H. 1959. The stem rot of peanuts and its control. Va. Agric. Exp. Stn. Tech. Bull.

144. 30 pp.
13. Garren, K. H., and Duke, G. B. 1958. The effects of deep covering of organic matter and non-dirting weed control on peanut stem rot. Plant Dis. Rep. 42:629-636.
14. Grichar, W. J., and Boswell, T. E. 1988. Comparison of no-tillage, minimum, and full tillage cultural practices on peanuts. Peanut Sci. 14:101-103.
15. Hartzog, D. L., and Adams, F. 1985. The effect of reduced tillage on peanut yields. (Abstr.). Proc. Am. Peanut Res. Educ. Soc. 17:33.
16. Jenkins, W. R. 1964. A rapid centrifugal-flotation technique for separating nematodes from the soil. Plant Dis. Rep. 48:692.
17. Knauft, D. A., Norden, A. J., and Beninati, N. F. 1981. Effects of intra-row spacing on yield and market quality of peanut (*Arachis hypogaea* L.) genotypes. Peanut Sci. 8:110-112.
18. Kvien, C. S., and Bergmark, C. L. 1987. Growth and development of the Florunner peanut cultivar as influenced by population, planting date and water availability. Peanut Sci. 14:11-16.
19. Minton, N. A., and Csinos, A. S. 1986. Effects of row spacings and seeding rates of peanut on nematodes and incidence of southern stem rot. Nematropica 16:167-176.
20. Minton, N. A., Parker, M. B.,and Flowers, R. A. 1975. Response of soybean cultivars to *Meloidogyne incognita* and to the combined effects of *M. arenaria* and *Sclerotium rolfsii*. Plant Dis. Rep. 59:920-923.
21. Minton, N. A., and Sayre, R. M. 1989. Suppressive influence of *Pasteuria penetrans* in Georgia soils on reproduction of *Meloidogyne arenaria*. (Abstr.). J. Nematol. 21:574-575.
22. Mixon, A. C. 1963. Effects of deep turning and non-dirting weed control on peanut stem rot. Ala. Agric. Exp. Stn. Bull. 344. 15 pp.
23. Mixon, A. C. 1969. Effect of row and drill spacing on yield and market grade factor of peanuts. Ala. Agric. Exp. Stn. Bull. 538. 35 pp.
24. Parker, M. B., Minton, N. A., Threadgill, E. D., Dowler, C. C., and Sumner, D. R. 1985. Tillage, nitrogen, herbicide, and nematicide effects on irrigated double-cropped corn and soybean in the coastal plain. Univ. Ga. Agric. Exp. Stn. Res. Bull. 326. 35 pp.
25. Rodriguez-Kabana, R., Backman, P. A., and Williams, J. C. 1975. Determination of yield losses to *Sclerotium rolfsii* in peanut fields. Plant Dis. Rep. 59:855-858.
26. SAS User's Guide. 1982. SAS Institute, Inc., Cary, NC. 584 pp.
27. Shear, G. M. 1968. The development of the no-tillage concept in the United States. Outlook Agric. 5:242-251.
28. Snedecor, G. W., and Cochran, W. G. 1967. Statistical Methods. 6th ed. Iowa State University Press, Ames. 593 pp.
29. Sturkie, D. G., and Buchanan, G. A. 1973. Cultural practices. Pages 299-326 in: Peanuts—Culture and Uses. American Peanut Research and Education Association, Stillwater, OK.
30. Wilcut, J. W., Wehtje, G. R., Colvin, D. L., and Patterson, M. G. 1987. Economic assessment of herbicide systems for minimum-tillage peanut production. Peanut Sci. 14:83-86.
31. Wright, F. S., and Porter, D. M. 1985. Conservation tillage of peanuts in Virginia. Proc. Am. Peanut Res. Educ. Soc. 17:34.